

FINAL DRAFT

**WATER QUALITY IMPROVEMENT
STRATEGIES
FOR THE EVERGLADES**

**ALTERNATIVE COMBINATIONS FOR THE
C-11 WEST BASIN**

March 21, 2002

**SOUTH FLORIDA WATER MANAGEMENT DISTRICT
West Palm Beach, Florida**

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comments or questions**

INTRODUCTION

The C-11 West Basin has an area of 72 square miles and is located in south central Broward County. A map of the C-11 West Basin is presented in *Figure 1*. The project canals and control structures in the C-11 West Basin have four functions: (1) to provide flood protection and drainage for the basin; (2) to supply water to the basin during periods of low natural flow; (3) to intercept and control seepage from Water Conservation Area (WCA) 3A; and (4) to maintain a groundwater table elevation west of S-13 adequate to prevent saltwater intrusion into local groundwater. There are four project canals in the C-11 West Basin: (1) C-11 West, (2) C-11 South, (3) the section of the L-33 borrow canal between C-11 and Pines Boulevard, and (4) the L-37 borrow canal. There are seven project control structures regulating flow in the C-11 West Basin: S-9, S-9XN, S-9XS, S-13A, G-86N, G-86S, and G-87.

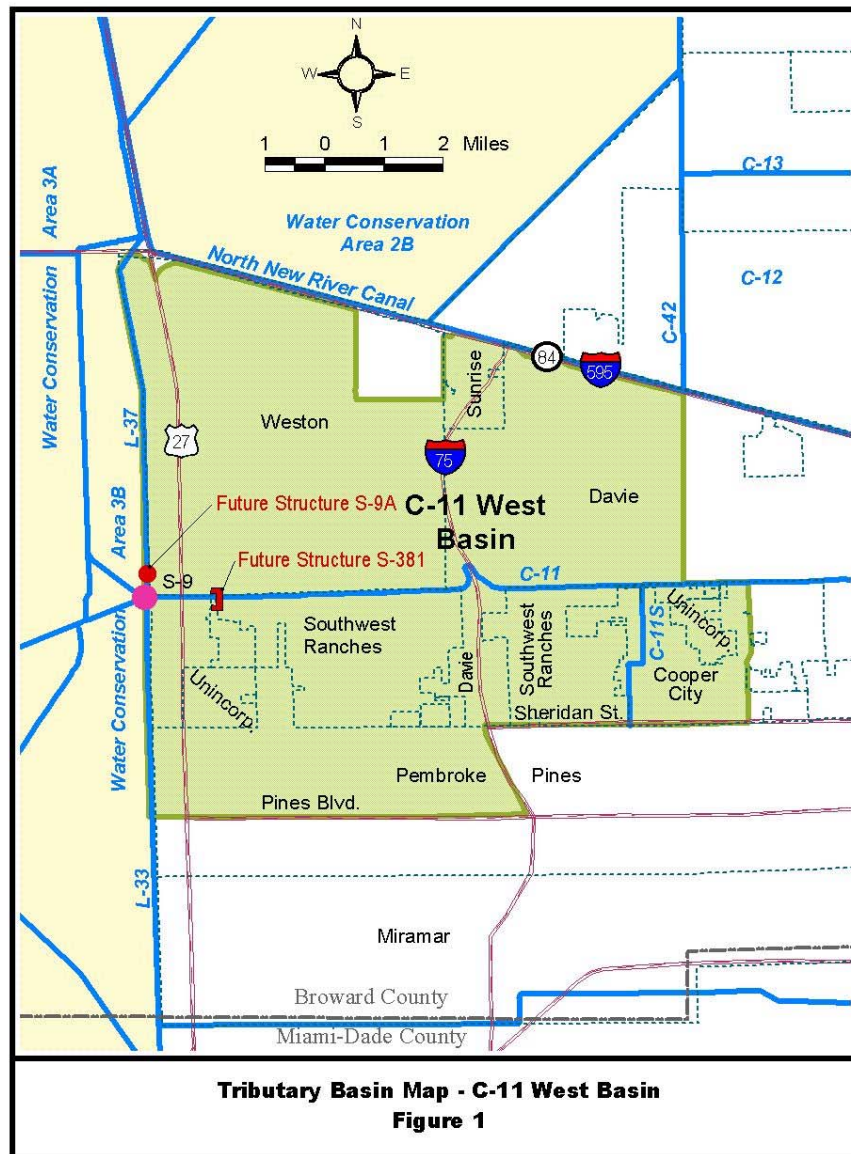
A Federal project, known as the C-11 West Basin Critical Project, is scheduled for construction within the basin. This project, which includes structural and operational changes to the water management system, is intended to isolate seepage coming from WCA 3A into the C-11 West Basin from stormwater generated within the C-11 West Basin. A proposed divide structure (S-381) along the C-11 West Canal, approximately 1 mile east of U.S. 27 (see *Figure 1*), will contain seepage west of this new structure. The seepage will be pumped back to WCA 3A through a new set of smaller pumps (structure S-9A) next to structure S-9 (see *Figure 1*). During non-storm conditions, S-9A pumps will operate continuously and will maintain C-11 West Canal elevations between 3.2 and 3.5 feet NGVD (a much narrower range of variation than the larger S-9 pumps, which now operate during storm and non-storm conditions). Therefore, it is expected the phosphorus levels going into WCA 3A will be reduced by backpumping clean seepage water and by reducing scour and drawdown by the larger S-9 pumps by continuously running the new smaller S-9A pumps. This project is scheduled for completion by December 2002.

CERP PROJECTS AFFECTING C-11 WEST BASIN: The C-11 West Basin CERP project, a.k.a., Western C-11 Impoundment & Diversion Canal project, consists of a 1,600 acre stormwater treatment area/impoundment and approximately 8 miles of canal that will divert flood waters to other storage areas (such as the C-9 Stormwater Treatment Area/Impoundment or the North Lake Belt Storage Area). This CERP project, planned to be completed by January 2006, is intended to manage urban runoff from the western C-11 Basin by capturing it in the stormwater treatment area/impoundment for later diversion to C-9 Basin, North Lake Belt Storage Area (once this other CERP project is completed in June 2036), or release into WCA 3A. The Western C-11 Impoundment will be located north of the C-11 West Canal and east of U.S. 27. A 2,575 cfs pump structure will divert flow from the C-11 Canal into the impoundment. The outflow from the impoundment will consist of a 2,500 cfs outflow structure. The North Lake Belt Storage Area CERP project, planned to be completed by June 2036, consists of a 4,500 acre reservoir just south of and connected to the C-9 Stormwater Treatment Area/Impoundment. Both CERP projects will affect the amount of stormwater flows pumped into WCA 3A through S-9 and seepage flows returned to WCA 3A through S-9A.

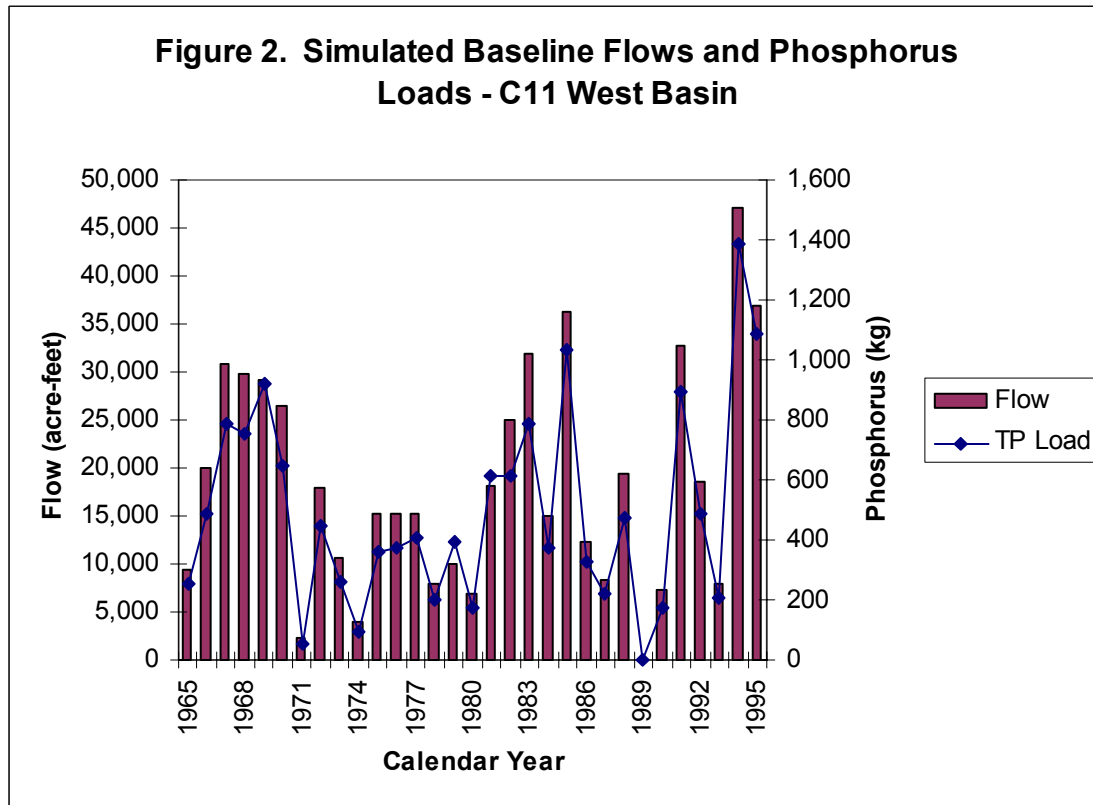
Although the Everglades Forever Act mandates compliance with state water quality standards by December 31, 2006, for the C-11 West Basin, the SFWMD Board passed a resolution to comply with the mandates by December 31, 2005 due to legal action by stakeholders.

Historic flow and water quality data from the S-9 pump station (DBKEY 15015) were compiled to generate the simulated C-11 West Basin data sets shown in *Figure 2* and *Figure 3*. Prior to December 96, when a composite sampler began collecting samples at S-9, all data were grab samples.

The anticipated effects of the C-11 West Basin Critical Project and CERP projects have been estimated and accounted for in the simulated C-11W Basin data sets shown in *Figure 2* and *Figure 3*. Note, seepage flows are not included in these summary figures.

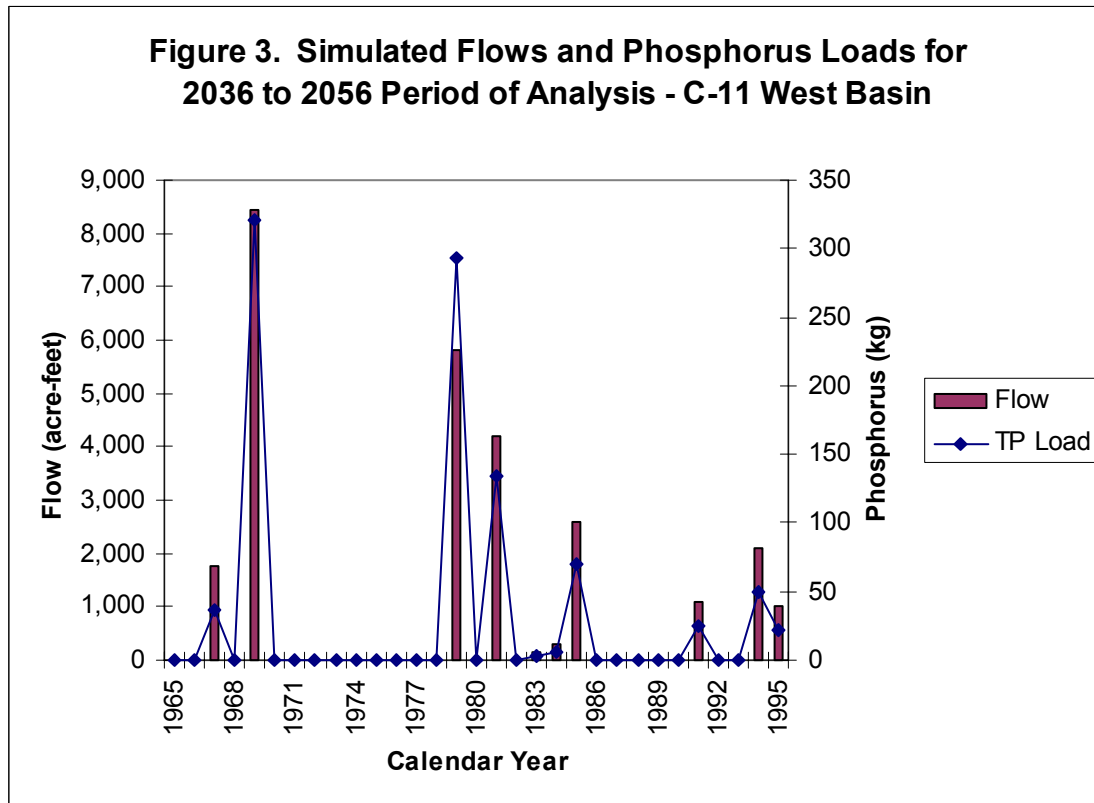


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*Note: Baseline Flows and Phosphorus Loads shown in *Figure 2* are comprised of simulated flows from the SFWMM and observed water quality data from the ten-year period WY 90-99. To develop the baseline flows, the SFWMM was used to simulate current operational conditions and utilized rainfall for the 31-year period between January 1, 1965 and December 31, 1995. The goal was not to recreate the 31-year period of record flows, but rather, to simulate the expected hydrologic response in the basin as a result of the 31-year rainfall history. For the water quality component, a regression relationship was developed between flow and phosphorus concentration. The resulting regression equation was applied to the simulated flows to create the 31-year period of Baseline flow and water quality data. Reference: *Baseline Data for the Basin-Specific Feasibility Studies to Achieve the Long-term Water Quality Goals for the Everglades*, SFWMD, May 2001.

The 31-year period simulated C-11 West Basin runoff Baseline data (*Figure 2*) yields average annual flows and total phosphorus loads of 18,283 acre-feet and 493 kilograms, respectively, and a corresponding average total phosphorus concentration of 22 ppb. This data set applies to the period of analysis from 2006 to 2036.



The 31-year period simulated C-11 West Basin runoff data (*Figure 3*) to be used for the 2036 to 2056 period of analysis yields average annual flows and total phosphorus loads of 885 acre-feet and 31 kilograms, respectively, and a corresponding average total phosphorus concentration of 28 ppb. The simulated flows and phosphorus loads shown in *Figure 3* were developed using the same method as was used to develop the Baseline data set shown in *Figure 2*.

ALTERNATIVES FOR C-11 WEST BASIN

Combinations of operational changes, source control, basin-scale treatment and CERP projects for the C-11 West Basin are presented below. Major components of the alternatives, along with probable influences on the flows and water quality of discharges to WCA 3A, are briefly described.

It should be noted that all three alternative combinations below assume implementation of source controls (Urban Best Management Practices (BMPs) and Regulatory Program) by December 2005. Further, all three alternative combinations assume implementation of the Western C-11 Impoundment & Diversion Canal CERP project by January 2006, and the North Lake Belt Storage Area CERP project by June 2036. Finally, it will be assumed that either the chemical treatment facility or stormwater treatment area (STA) will be completed by December 2005. It is assumed that all alternatives will maintain existing levels of flood protection within the basin.

Alternative 1

- Source Control Component: Urban BMPs and Regulatory Program (December 2005)
- Chemical Treatment Component (December 2005)
- CERP Component: Western C-11 Impoundment & Diversion Canal (January 2006) and North Lake Belt Storage Area (June 2036)

Alternative 2

- Source Control Component: Urban BMPs and Regulatory Program (December 2005)
- STA Component (December 2005)
- CERP Component: Western C-11 Impoundment & Diversion Canal (January 2006) and North Lake Belt Storage Area (June 2036)

Alternative 3

- Source Control Component: Urban BMPs and Regulatory Program (December 2005)
- CERP Component: Western C-11 Impoundment & Diversion Canal (January 2006) and North Lake Belt Storage Area (June 2036)

Note: Separable costs will be provided for previously purchased land(s) which are to be incorporated in alternatives.

Alternative 1 – Implement Source Control Component and Chemical Treatment Component by December 2005. Implementation of Western C-11 Impoundment & Diversion Canal CERP Project in January 2006 and Implementation of North Lake Belt Storage Area CERP Project in June 2036.

Description:

- A. Source Control:** It is assumed that urban stormwater BMPs, as defined by the Everglades Stormwater Program, will be implemented in the C-11 West Basin.
- B. Chemical Treatment:** This component involves the construction of a chemical treatment facility and land acquisition by December 2005. It is assumed that the chemical treatment facility will consist of a pump structure which diverts the C-11 West stormwater into a flow equalization basin followed by a Mixing/Flocculation/Sedimentation area and a return structure.
- C. CERP and Critical Projects:** The CERP and Critical projects affecting the C-11 West Basin were described in the introduction section above. The Baseline data set reflects the anticipated effect of the CERP and Critical projects.

Influence on Flow:

- A. Source Control:** It is assumed that there will be no reduction in the Baseline flows associated with source controls.
- B. Chemical Treatment:** It is assumed that there will be no reduction in the Baseline flows associated with the chemical treatment facility.
- C. CERP and Critical Projects:** Two sets of flows will be analyzed, one covering the period January 2006 through June 2036, and the other covering the period June 2036 through December 2055.

Influence on Water Quality:

- A. Source Control:** A source control sensitivity analysis will not be performed for this component.
- B. Chemical Treatment:** It is assumed that the chemical treatment facility will achieve a total phosphorus outflow concentration of 10 ppb regardless of the inflow concentration. As part of a sensitivity analysis, the chemical treatment effluent will be assumed to be 6 ppb and 8 ppb and the influence these concentrations, and the resultant blending of treated and untreated flows, have on the 50-year present worth cost will be evaluated and summarized. After the North Lake Belt Storage Area CERP project is completed in June 2036, a reduced amount of stormwater flow will be pumped into WCA 3A through S-9. It is assumed that a downsized chemical treatment facility will be used to treat the reduced flows.
- C. CERP and Critical Projects:** Two sets of loads will be analyzed, one covering the period January 2006 through June 2036, and the other covering the period June 2036 through December 2055.

Costs:

- A. Source Control:** There will be no cost estimates developed for this component.
- B. Chemical Treatment:** A chemical treatment facility, land acquisition, levees, structures, borrow canals, and O & M costs, etc., will be required in order to implement this alternative.
- C. CERP and Critical Projects:** There will be no additional cost associated with this component.

Alternative 2 – Implement Source Control Component and STA Component by December 2005. Implementation of Western C-11 Impoundment & Diversion Canal CERP Project in January 2006, and Implementation of North Lake Belt Storage Area CERP Project in June 2036.

Description:

- A. Source Control:** It is assumed that urban stormwater BMPs, as defined by the Everglades Stormwater Program, will be implemented in the C-11 West Basin.
- B. STA Component:** This component involves the construction of an STA and land acquisition by December 2005. It is assumed that the STA facility will consist of a pump structure which diverts the C-11 West stormwater into said STA, followed by a return structure. The STA will be designed to reduce TP to the lowest sustainable concentration using the optimal combination of emergent, submerged aquatic vegetation (SAV), and PSTA.
- C. CERP and Critical Projects:** The CERP and Critical projects affecting the C-11 West Basin were described in the introduction section above. The Baseline data set reflects the anticipated effect of the CERP and Critical projects.

Influence on Flow:

- A. Source Control:** It is assumed that there will be no reduction in the Baseline flows associated with source controls.
- B. STA Component:** It is assumed that there will be no reduction in the Baseline flows associated with this component.
- C. CERP and Critical Projects:** Two sets of flows will be analyzed, one covering the period January 2006 through June 2036, and the other covering the period June 2036 through December 2055.

Influence on Water Quality:

- A. Source Control:** As part of a sensitivity analysis, the phosphorus load associated with discharges from the C-11 West Basin (from the Baseline data set) will be reduced by 25%, and the influence that this reduction has on the amount of land required for the STA will be calculated and summarized.
- B. STA Component:** It is assumed that the STA facility will achieve a reduced total phosphorus outflow concentration compared to the Baseline data set. After the North Lake Belt Storage Area CERP project is completed in June 2036, a reduced amount of stormwater flow will be pumped into WCA 3A through S-9. It is assumed that a downsized STA will be used to treat the reduced flows.
- C. CERP and Critical Projects:** Two sets of loads will be analyzed, one covering the period January 2006 through June 2036, and the other covering the period June 2036 through December 2055.

Costs:

- A. Source Control:** There will be no cost estimates developed for this component.
- B. STA Component:** Land acquisition, levees, structures, borrow canals, limerock, and additional O & M costs, etc., will be required in order to implement this alternative.
- C. CERP and Critical Projects:** There will be no additional cost associated with this component.

**Alternative 3 – Implement Source Control Component by December 2005.
Implementation of Western C-11 Impoundment & Diversion Canal
CERP Project in January 2006, and Implementation of North Lake
Belt Storage Area CERP Project in June 2036.**

Description:

- A. Source Control:** It is assumed that urban stormwater BMPs, as defined by the Everglades Stormwater Program, will be implemented in the C-11 West Basin.
- B. CERP and Critical Projects:** The CERP and Critical projects affecting the C-11 West Basin were described in the introduction section above. The Baseline data set reflects the anticipated effect of the CERP and Critical projects.

Influence on Flow:

- A. Source Control:** It is assumed that there will be no reduction in the Baseline flows associated with source controls.
- B. CERP and Critical Projects:** Two sets of flows will be analyzed, one covering the period January 2006 through June 2036, and the other covering the period June 2036 through December 2055.

Influence on Water Quality:

- A. Source Control:** As part of a sensitivity analysis, the phosphorus load associated with discharges from the C-11 West Basin (from the Baseline data set) will be reduced by 25%, and the influence this reduction has on the phosphorus loads to the EPA will be calculated and summarized.
- B. CERP and Critical Projects:** Two sets of loads will be analyzed, one covering the period January 2006 through June 2036, and the other covering the period June 2036 through December 2055.

Costs:

- A. Source Control:** There will be no cost estimates developed for this component.
- B. CERP and Critical Projects:** There will be no additional costs associated with this component.

APPENDIX A

ADDITIONAL BACKGROUND INFORMATION

Source Control Component

Basin-wide Source Controls. Source controls will require the implementation of a comprehensive and basin-wide pollution prevention plan. The plan must include regulation promulgation, public education, hiring and equipping maintenance personnel, infrastructure improvements, and hiring compliance and enforcement staff. These basin-wide source controls will consist of Urban BMPs and Regulatory Programs.

Urban Best Management Practices are stormwater management practices for urban areas. Examples include landscaping and vegetative practices, illicit discharge controls, litter and debris control, detention ponds and preventative maintenance programs.

Regulatory Programs (Permits and Permit Modifications) are developed to improve water quality, including identifying structures or systems requiring permits or modifications to permits. Regulatory programs may include any combination of voluntary BMPs, requirement and/or modification of permits, construction projects and basin-specific regulatory programs to achieve compliance with state water quality standards.

C-11 WEST BASIN MONITORING RESULTS

Table A-1 and Figures A-1, A-2, and A-3 below show preliminary total phosphorus monitoring results at different sampling locations within the three 298 districts within the C-11 West Basin (South Broward Drainage District, Central Broward Water Control District, and Indian Trace Development District).

Table A-1

Preliminary C-11 West Basin Sampling Results: Phosphorus Concentrations in ppb																								
Sampling Date	3/21/00	3/28/00	7/14/00	7/27/00	7/28/00	8/3/00	10/4/00	3/20/01	5/24/01	5/25/01	6/26/01	6/29/01	7/11/01	8/2/01	8/3/01	9/7/01	9/10/01	9/14/01	10/1/01	10/22/01	10/23/01	11/5/01	2/11/02	2/12/02
SBDD Stations																								
C110.0TS1						13							22	18			9			20		14	5	
C1100.8TS			7			8				7	8		7				7			7		7	5	
C1101.0TS										648			170	280						660		180		
C1101.3TS			15			21				46	15		17				48		16	13		10	10	
C1102.0TS			19			17		34		50	33		27				15		17	11		10	10	
C1102.1TS										630			200							300				
C1102.8TS			108		22	29		90		139	35		45				26			33		13	19	
C1103.3TS			119			121				138	190		220	160			23		130	69		54	14	
C1103.5TS													51											
C1104.3TS					24	20				111			34	28					22	32		39		
C1104.6TS			27							23	19		23				7			13		13	9	
C1104.9TS			40							101	50		73				21			26		18	16	
C114.3TS1													13				13		13	13		10	13	
C112.8TS1					13	12							11	12			7		9	7		7	10	
C112.0TS1						20							14	20			31		15	7		10	10	
CBWCD Stations																								
C1105.40TN (N-32)		18		35			59			16		12	24		22	7					42			
C1106.30TN (N-31)	46			94			151	99	101			84	93		83	19					75			
C1107.50TN (N-27)	29			113			94	38		35		18	30		61	12					41			
C1108.50TN (N-23)		24		48			164			54		41	57		81						54			
C1109.00TN (N-22)		23		59			312		89						22	13					120			
C1109.60TN (N-20)		16		28					27			17	21		39	7					53			
C1110.10TN (N-18)	24			25				11	23			19	14		42	6					29			
C1110.60TS (S-22)	23			42			172			18		14	17		17	9					37			
C1107.50TS (S-35)		25			17					12		21	14		17	8					15			
C1108.50TS (S-31)		29			28					18		11	28		120	14					8			
C1109.00TS (S-30)		26			195		94			28		22	59		23	9					8			
C1109.30TS (C-11S)	15				16					14		8	17		20	8					8			
Weston Stations																								
C1101.0TN														25				20			14			7
C1101.5TN														9				12			8			7
C1102.1TN							53							21				16			19			8
C1102.7TN							29		21					26				18			21			14
C1104.3TN							23		21					15				13			14			11
C111.7TN1																		11			9			7

Figure A-1

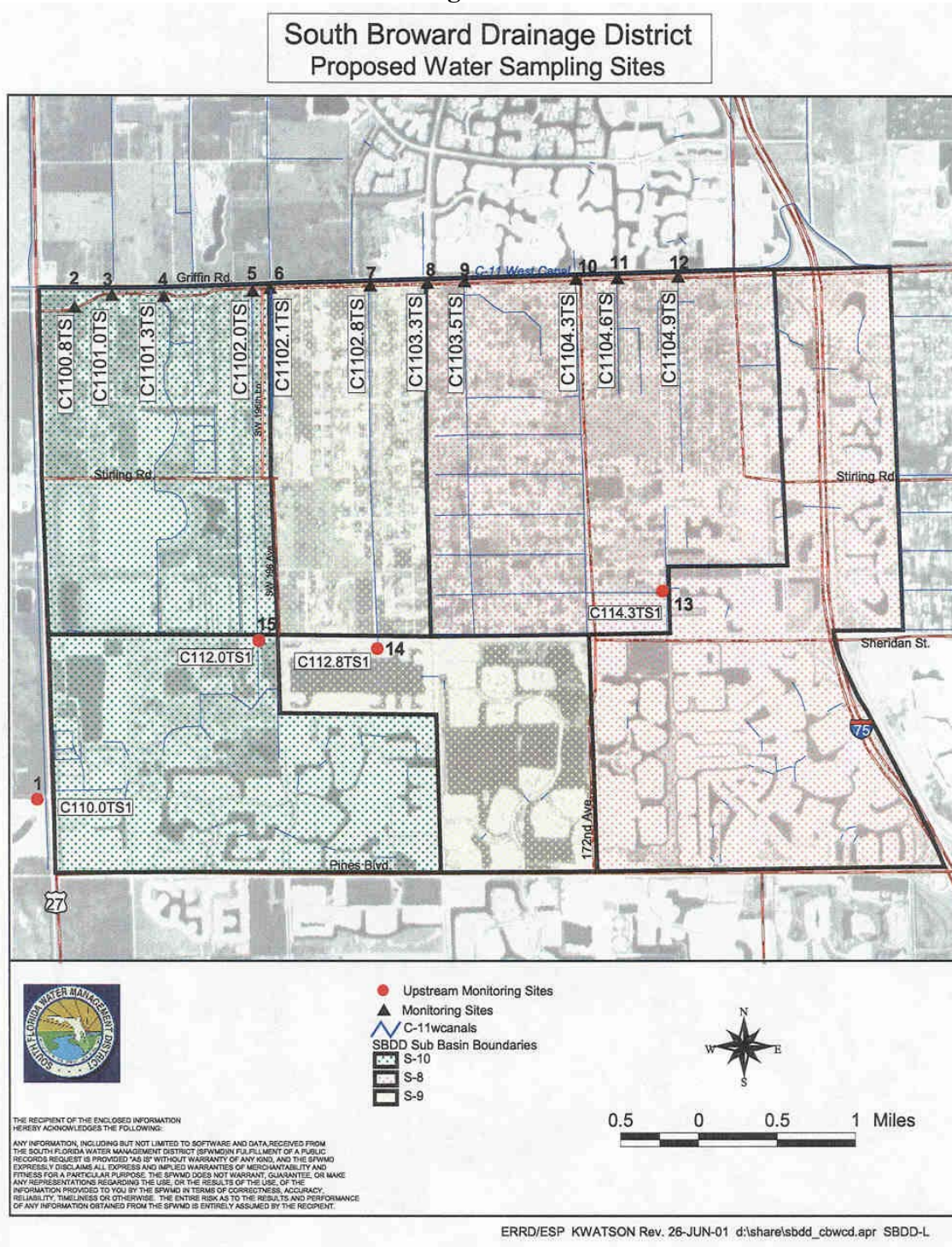


Figure A-2

C-11W - CBWCD

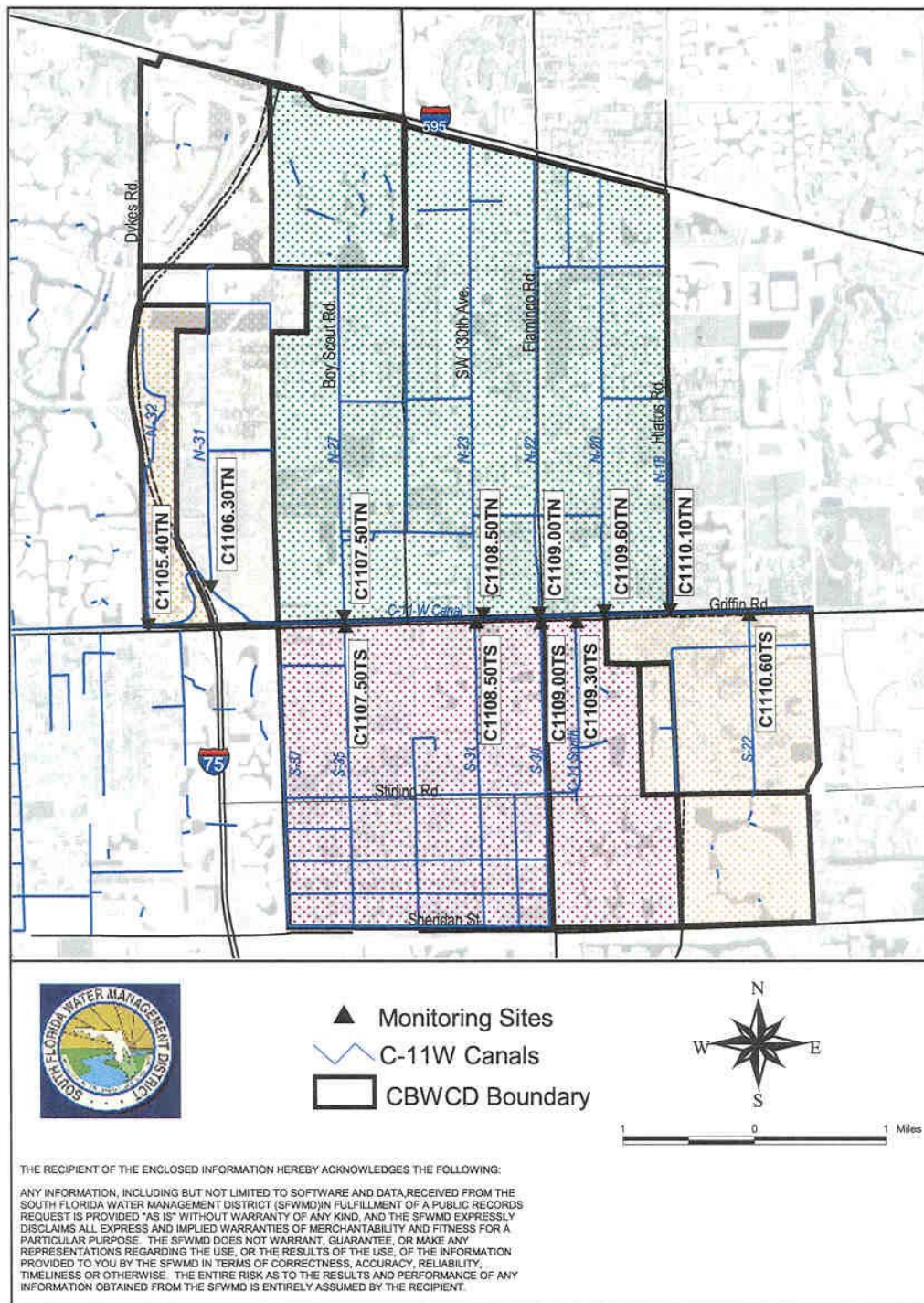
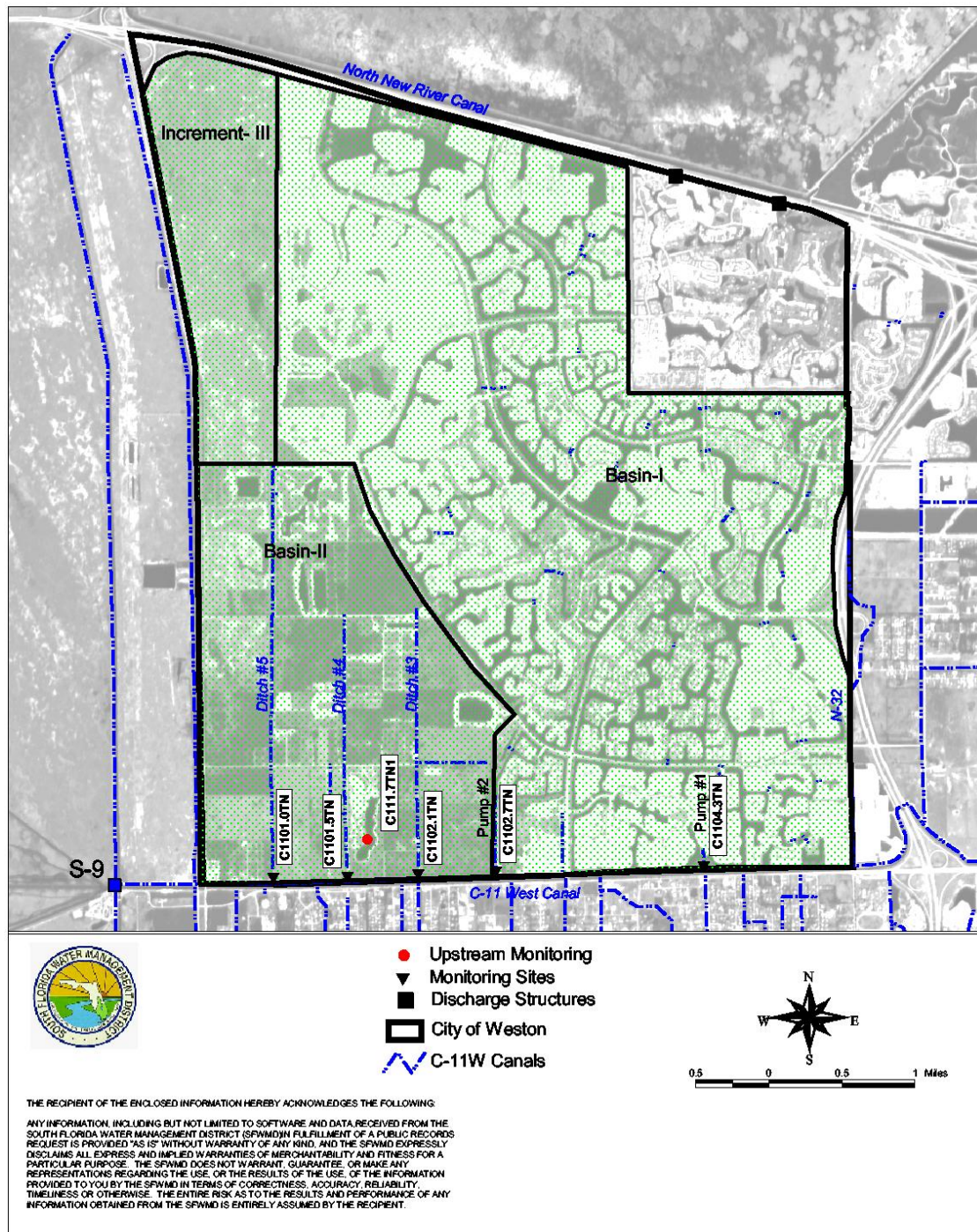


Figure A-3

Indian Trace Development District - City of Weston



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